SECTION III
INSTRUMENTATION AND AVIONICS

CONTENTS

INSTRUMENTATION

The Model 525 CitationJet is equipped with a Rockwell Collins Pro Line 21 Integrated Avionics System which includes display, flight director guidance, autopilot, yaw damper and pitch trim functions. The integrated avionics system is designed and intended for single pilot operations. The basic system is comprised of the following subsystems:

- Two (2) AFD-3010 Adaptive Flight Displays (Pilot's Primary Flight Display (PFD) and Multifunctional Display (MFD)
- Flight Control System (3 axis)
- Two AHC-3000 Attitude Heading Computers
- ADC-3000 Air Data Computer and associated temperature probe
- Integrated Avionics Processor System
- Radio Altimeter
- Angle-of-Attack Computer
- Weather Radar
- External Global Positioning System (GPS) and Flight Management System (FMS) - OPTIONAL

In the optional second PFD configuration, additional subsystems included are:

- Copilot's PFD
- Copilot's ADC-3000

The integrated avionics system includes the following displays and controls: Primary Flight Display (PFD), Multifunctional Display (MFD), Display Control Panel, Course Heading Panel, Autopilot Panel, and Mode Select Panel. In the optional second PFD configuration, the additional displays and controls installed on the copilot's side of the panel are: Primary Flight Display (PFD), Display Control Panel, Course Knob Panel, Mode Select Panel. A version of the APP-85 Autopilot Panel also includes an autopilot transfer button.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

The upper portion of the PFD displays the basic "T" flight instruments: an attitude director indicator (ADI), altitude scale, airspeed scale and vertical speed scale. In addition, Flight Control System mode information is displayed in the area above the ADI, and radio altitude data is shown on the attitude display. The lower portion of the PFD screen is used to display a rose, arc, or optional FMS MAP navigation format as selected by the pilot. Weaher radar and lightning symbology can be overlayed on the ARC or MAP format. The area on either side of the rose, arc or map format is used to display a lateral navigation data field, a weather radar mode field, system messages and selected menu data. Normal control, reversion and warning annunciations also are displayed. The PFD can be pilot-configured as a combined PFD/MFD to serve as a backup in the event of multifunction (MFD) failure.

On the MFD, the upper portion of the screen displays the Engine Indication System. The lower portion displays a rose, arc, FMS map or FMS plan map format as selected by the pilot. The area on either side of the rose, arc or map format is used to display a lateral navigation data field, a weather radar mode field and selected menu fields. A data line is displayed along the bottom of the MFD display with groundspeed, true airspeed and temperature readouts. Normal control, reversion and warning annunciations also are displayed. Like the PFD, the MFD can be pilot-configured as a combined PFD/MFD to serve as a backup in the event of PFD failure.

Line select keys on both the PFD and MFD provide the primary pilot interface. Control of the basic display formats is via the bezel mounted line select keys located on each display. Control of the radar, navigation sources, bearing pointers, speed and altitude referecnes is via the line select keys. Control of the course, selected heading and selected altitude is via the course/heading panel. In the optional second-PFD configuration, an autopilot transfer button is provided.

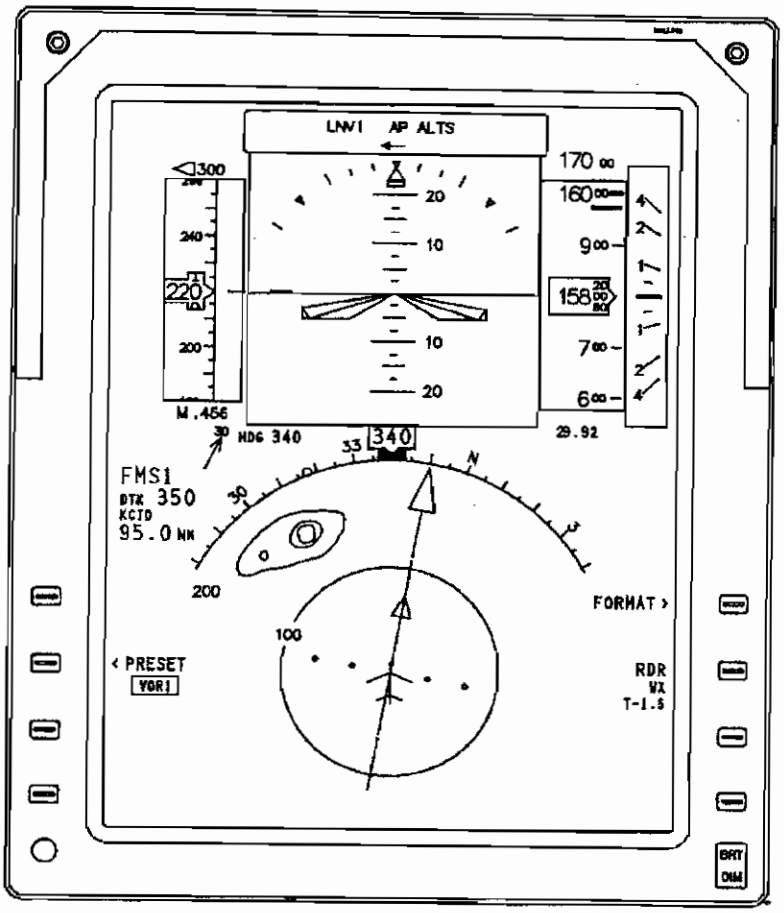


Figure 3-1. Primary Flight Display (PFD)

PITOT-STATIC

The Model 525 CitationJet is equipped with separate pilot-static systems located on the left and right sides of the airplane. For the two display system, the left side pitot tube supplies pressure to the air data computer which, after converting the data into digital information, forwards the data through the system to the pilot's primary flight display The pitot tube on the right side of the airplane supplies pressure to the copilot's airspeed indicator. In the optional three display system, pitot pressure from the tube of the right side of the airplane serves the copilot's air data computer.

Two static ports are located on each side of the airplane providing a static source for the pilot's air data computer. The other port on each side provides a static source for the copilot's airspeed indicator, altimeter, instantaneous vertical speed indicator, and the cabin differential pressure gage. The gear warning airspeed system and the mach airspeed warning are provided by the Pro Line 21 Avionics System via the Air Data Computer.

VERTICAL SPEED INDICATOR

The copilot's instantaneous vertical speed indicator indicates vertical velocity from 0 to 6000 feet per minute, either up or down. Operation of the flight instrument differs from conventional VSIs in that there is less time lag between airplane displacement and instrument indication. Accelerometers sense any change in normal acceleration and displace the needle before an actual pressure change occurs.

ENGINE INSTRUMENTS

The engine operating parameters of fan RPM, inter-turbine temperature (ITT), turbine RPM, fuel flow, oil temperature, and oil pressure are monitored by the Engine Indicating System (EIS) through a color display on the upper screen segment of the center MFD. The EIS consists of four identical data concentration units. Of the four units, two are configured as data concentrator units , receiving analog and discrete data inputs from the engines and other airplane systems. The left and right data concentrator units output engine data to the respective EFIS displays.

Engine data from the EIS is shown in either normal or compressed format at the top of the MFD. The fan (N_1) display consists of the N_1 legend, N_1 pointers, N_1 scale and N_1 readouts. Two N_1 pointers (analog) are used with the N_1 scale to show the current fan speeds for the left and right engines. These pointers are white vertical bars that extend from the bottom of the scale to the current N_1 value. The N_1 digital readouts show the current fan speeds as numerical values (100 percent fan RPM = 17,245). The two N_1 readout values are green for valid data less than or equal to 104.4 percent, yellow for valid data from 104.5 to 105.3 percent for less than 20 seconds, and red for valid data (1) from 104.5 to 105.3 percent for 20 seconds or more, or (2) equal to or more than 105.4 percent. The N_2 display consists of the N_2 legend and the N_2 digital readouts. The two N_2 readouts are green for valid data less than or equal to 99.3 percent and red for valid data equal to or more than 99.4 percent (100 percent = 41,200 RPM).

The ITT display shows the interstage turbine temperature for each engine in degrees Centigrade on a scale range from 100 to 1050 degrees C. The display consists of the ITT legend, ITT pointers, ITT scale, and ITT start limit bugs. The scale values (starting engine) are green if from 100 to 1000 degrees C. and red if from 1002 to 1050 degrees C. The scale values (engine running) are green if from 100 to 796 degrees C., yellow if from 798 to 820 degrees C. for less than 5 minutes and red if (1) from 798 to 820 degrees C. for 5 minutes or more, or (2) from 822 to 1050 degrees C.

The fuel flow display shows the fuel flow in pounds per hour or kilograms per hour for each engine. The fuel quantity display shows the fuel quantity remaining for each in engine in pounds or kilograms. This consists of the fuel quantity legend, the fuel quantity pointers, the fuel quantity scale, fuel quantity readouts, and fuel quantity units. The oil pressure display shows the current oil pressure for each engine in pounds per square inch, while oil temperature is displayed on a scale from 0 to 140 degrees C.

The fuel temperature readouts display the temperature in their respective wing tanks in degrees Centigrade only. Each fuel temperature readout consists of up to two digits with a leading negative sign, when appropriate.

MAGNETIC COMPASS

A standard liquid filled magnetic compass is mounted above the glareshield.

FLIGHT HOUR METER

The meter, located on the copilot's meter panel, displays the total flight time on the airplane in hours and tenths. The landing gear squat switch activates the meter when the weight is off the gear. A small indicator on the face of the instrument rotates when the hour meter is in operation.

STANDBY ATTITUDE INDICATOR

In both the two- and three-PFD instrument panel configurations, the standby attitude indicator is located on the upper right side of the center panel. The gyro normally operates on 29 volts direct current (VDC) power from the number one main bus. It is powered through a five-ampere circuit breaker marked STDBY GYRO on the left circuit breaker panel. Power to the gyro is controlled by a switch marked STDBY GYRO/OFF/TEST located on the pilot's switch panel. The gyro has an emergency source of power from an emergency battery pack located in the nose avionics compartment of the airplane. If the airplane bus voltage falls below a minimum amount, gyro power will be supplied from the battery pack. The battery pack also provides emergency instrument lighting for the standby gyro.

The battery pack is constantly charged by the airplane's electrical system, and should therefore be fully charged in the event of an electrical power failure. The gyro power switch must be ON for automatic transfer to battery power to occur. The standby gyro will operate for a minimum of 30 minutes on battery power. An amber POWER ON light next to the STDBY GYRO switch illuminates when the gyro is turned ON and the airplane's electrical system is not charging the emergency power supply batteries. When the STDBY GYRO switch is held to the spring-loaded TEST position, a self-test of the battery and circuits is accomplished. The green GYRO TEST light, also next to the STDBY GYRO switch, will illuminate if the test is satisfactory and the battery is sufficiently charged. The gyro is caged by pulling the PULL TO CAGE knob.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system is powered by 29 volts direct current (DC) through a five-ampere circuit breaker on the left main DC bus. It incorporates a signal summing unit (computer), an angle-of-airflow sensing vane, a flap position sensor, an angle-of-attack indicator and an optional indexer. The angle-of-attack system activates a stick shaker, located on the pilot's control column, at a predetermined angle of attack. The stick shaker provides tactile warning of impending stall.

The vane type angle-of-airflow sensor, including associated transducer, is mounted on the right forward fuselage of the airplane. The swept airfoil-shaped vane streamlines with the relative airflow and the transducer sends a signal to the computer located in the right console.

The flap position sensor provides a signal to the computer, allowing compensation for any flap position selected. The computer then provides a signal to drive the AOA indicator (and EADI LAA display and optional indexer) which is accurate throughout the weight and CG range of the aircraft.

The AOA indicator is a full range type, calibrated from 0.1 to 1.0 and marked with red, yellow and white arcs. The 0 represents a very low angle-of-attack, whereas the 1.0 indicates the aircraft has exceeded the critical angle-of-attack and has stalled. The area from 0.1 to 0.57 represents the normal operating range of the airplane, except for approach and landing. The white arc (0.57 to 0.63) covers the approach and landing range with the middle of the arc. For each flap configuration 0.60 is calibrated to represent 1.3 V_{S1}; this equates to V_{APP} for 15° flaps and V_{REF} for 35° flaps.

When the annunciation flashes it indicates that the system is in ET set mode and a time of up to 59 hours and 59 minutes may be preset into the elapsed timer, with the concentric knobs. The preset time will be displayed and remain unchanged until SET/RESET is pressed again, which will start the countdown from the preset time. When the timer reaches :00 it will begin to count up and the display will flash for about 15 seconds. While flight time (FLT) or elapsed time (ET) modes are being displayed, the standby frequency is kept in memory. It may be called back by pressing the FRQ button, and then transferred to the active frequency by pressing the FRQ button again.

While FLT or ET is displayed, the in use frequency on the left side of the display may be directly changed by using the frequency select knobs, without any effect on the stored standby frequency or the other modes. This feature is useful when tuning for stations the exact frequency of which the operator may not know.

A second KR-87 ADF may be installed, in which case the first system is duplicated with a second complete system, and operation of the second ADF is identical to the first. If a second ADF is installed, its bearing information may be displayed on the bearing needle on the pilot's or copilot's HSI.

ATTITUDE HEADING REFRENCE SYSTEM (AHRS)

The Collins Attitude Heading Reference System (AHRS), consisting of two attitude heading computers, provides linear acceleration data to the flight control system. In addition, the AHRS supplies attitude and stabilized magnetic (or free gyro) heading to the following subsystems: Electronic Flight Instrument System (EFIS), Integrated Avionics Processor System (IAPS), Weather Radar System (WXR), Lightning Detection System (LDS) and the Flight Management System (FMS). The attitude heading computers, which are physically and functionally separated from each other, utilize inertial sensors to generate digital data to obtain three-axis angle, rate and acceleration information. The computers receive magnetic flux inputs from the flux detector unit, compass compensation from the external compensation unit, and strut switch logic from the integrated avionics processor system. In turn, the attitude heading computers supply attitude, stabilized magnetic (or free gyro) heading and linear acceleration outputs.

The flux detector unit uses a pendulous sensing element to detect the direction of the magnetic field of the earth. This input is utilized for computing stabilized magnetic heading. The external compensation unit provides alignment and compass correction data needed to cancel compass errors caused by misalignment of the flux detector unit and the airplane on the magnetic field of the earth. This data is airplane specific and is obtained during AHRS leveling and compass swing procedures.

For normal operation, no pilot control is required. However, for each AHRS, a switch mounted on the flight deck provides a means to select the directional gyro mode. In addition, switches are provided for left and right slewing. AHRS transfer (reversion) to the cross-side AHRS is also selected via flight deck mounted switches. No other pilot control operation is required.

Once activated, the ELT must be reset using one of the following methods:

- From the cockpit, place the switch to the ON position. Ensure the ELT ACTIVATED WHEN LIT indicator light is illuminated. Immediately place the switch to the ARM position. Ensure the light is extinguished.

- From the transmitter, place the switch to the ON position, and then immediately place the switch to the OFF position.

NOTE

Normal switch configuration is for the transmitter switch to be placed in the OFF position and the cockpit switch to be placed in the ARM position. It is impossible to disarm the ELT by improper placement of the cockpit (or transmitter) switches.

System testing is accomplished by placing the cockpit switch in the ON position, observing steady illumination of the ELT ACTIVATED WHEN LIT indicator light for the first three seconds, and confirming audio tone through a COMM radio tuned to either 121.5 or 243.0 MHz. Once testing is complete, ELT must be reset.

FLIGHT GUIDANCE

ROCKWELL COLLINS PRO LINE 21 FLIGHT CONTROL SYSTEM

The Rockwell Collins Pro Line 21 Flight Control System (FCS) is an integrated three-axis autopilot with yaw damper, flight guidance, and automatic pitch trim. The FCS provides fail-safe autopilot and dual flight guidance functions. The system consists of two identical FGC-3000 Flight Guidance Computers (FGCs), three SVO-3000 Primary Servos, an APP-85 Autopilot Panel, and a MSP-85 Mode Select Panel. The latest revision of the Rockwell Collins pilot's guide is provided with the airplane and must be on board the airplane immediately available to the crew.

The FCS consists of an autopilot panel (APP), two flight guidance computers (left and right FGC), one two-mode select panels (left and right MSP), and three primary servos. The FGC receives Flight Director mode select data from the MSP and vertical speed/pitch wheel input, autopilot engage logic from the APP, attitude and heading data from the onside Attitude Heading Computer, and cross-side data from the opposite FGS. The APP provides engage clutch power to the servos and autopilot engage inputs to both FGCs. The controls integrated in the APP include the ROLL knob, vertical speed/pitch wheel, autopilot engage lever, yaw damper engage lever, TURB and AP XFR controls. Control inputs from the APP are applied to both FGCs.

Command of the FCS is accomplished using the APP-85 Autopilot Panel controls and the MSP-85 Mode Select Panel push button mode selectors, along with yoke-mounted SYNC (vertical synchronization), AP DISC (autopilot disconnect) and GA (go-around) switches. When the flight director is active and the autopilot is disengaged, the pilot manually maneuvers the airplane in response to the selected flight guidance by observing the flight director display. When the autopilot is engaged, the autopilot maneuvers the airplane in response to the selected flight guidance, and the pilot monitors the flight path by observing the commands displayed by the flight director.

The yaw damper provides yaw damping and turn coordination. The automatic pitch trim system trims out sustained elevator forces when the autopilot is engaged. Whether the autopilot is engaged or disengaged, the flight control system provides commands to:

- Hold a pressure altitude.
- Hold a vertical speed.
- Hold an indicated speed.
- Capture and track a selected altitude.
- Capture and track a selected heading.
- Capture and track a selected radio course (VOR, LOC,G/S).
- Capture and track a lateral navigation course.
- Maintain a wings-level, fixed pitch-up attitude for go-around.

NOTE

The APS-3000 is available with a single flight director avionics package designed for single-pilot operation and a dual FD avionics package for dual pilot operation.

The two FGCs are installed within the IAPS card cage located in the nose compartment of the airplane. Computation circuits in the left FGC receive discrete control data from cockpit switches, attitude and heading data from the left AHC, concentrator data from both IOCs, crosstalk data from the right FGC, and flight director mode select/engage date from the left MSP. The right FGC operates in the same way, except that it functions with right side circuits. The two systems operate together to drive the servos and the electric trim.

Mode Selection

The MSP-85 Mode Select Panel (MSP) provides push buttons used by the pilot to select and deselect flight guidance modes. The lateral and vertical mode select controls as well as the flight director on/off control are located on this panel. A mode cannot be selected unless all conditions required by that mode are present. The left MSP is used by the pilot to set the flight director modes for the left side flight guidance system. The optional right MSP is used by the copilot to set the flight director modes for the right side flight guidance system. Control inputs from the MSP are applied to both FGCs. A mode interlock within each individual FGC illuminates the MSP annunciators.

Several additional flight controls are external to the APP and MSP. These include an AP DISC switch, GA switch, pitch synchronization switch (AP Sync), and pitch trim control. The SVO-3000 servos physically position the airplane control surfaces (elevator, ailerons, and rudder).

The two FGCs are installed within the IAPS card cage located in the nose compartment of the airplane. Computation circuits in the left FGC receive discrete control data from cockpit switches, altitude and heading data from the left attitude/heading computer, crosstalk data from the right FGC, and flight director mode select-engage data from the left Mode Select Panel. The right FGC operates in the same manner, except that it functions with right side circuits. The two systems operate together to drive the servos and the electric trim

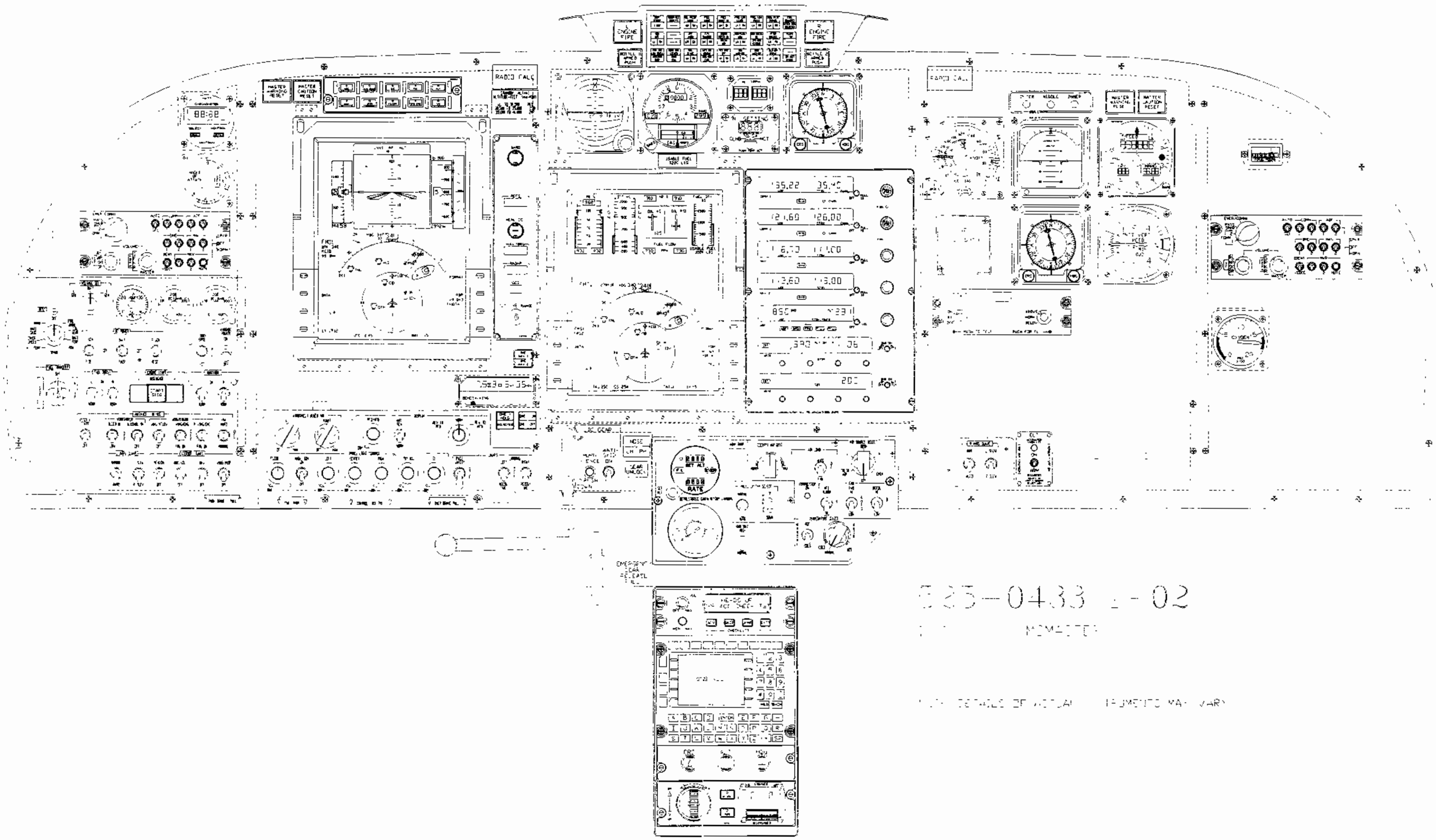
For single PFD installations, all flight director steering commands displayed on the PFD come from the left FGC. No XFR side arrow is displayed and there is no AP XFR switch. For the optional second PFD configuration, a copilot side flight director is provided. Additional hardware on the copilot's side includes and MSP and an APP with an autopilot transfer button. The pilot's and copilot's flight director modes are synchronized so that either pilot may select the new mode from the associated MSP. The exception to this is when in an APPR and GA mode, where independent guidance information is provided to each pilot. With dual PFDs, the pilot selects which FGS is in control via the AP XFR switch located on the APP-85. A XFR arrow in each PFD indicates which FGS is active. Each PFD displays the FD commands from the FGS computer selected with the SFR switch, except for go-around (GA) and approach (APPR) modes. The APPR and GA modes are referred to as independent modes, and only the on-side FGS is used by the respective PFD for independent modes.

NOTE

Except for Overspeed mode, turning off the flight directors and disengaging the autopilot cancels the active mode.

The following is a summary of flight guidance modes:

- Flight Director Mode - The flight director is the flight control system; steering commands and mode annunciations are displayed on the PFD.
- Roll Hold Mode - Roll hold is the basic lateral operating mode. Roll hold is active when no other lateral mode is active. Roll hold has no mode select button.
- Heading Select Mode - The HDG button on the mode select panel is used to select heading-select mode (push-on/push-off). Heading select mode generates commands to capture and track the heading reference.
- Navigation Mode - The NAV button on the mode select panel is used to select navigation mode (push-on/push-off). Navigation mode generates commands to capture and track guidance for enroute navigation and non-precision approaches.
- Approach Mode (Lateral and Vertical) - Approach mode, activated by the APPR button on the mode select panel, is capable of performing course captures from intercepts, which differ from the selected course by 90 degrees. When armed, lateral and vertical approach modes monitor airplane closure rate toward the selected course/glide path and calculates the optimum capture point.
- Back Course Mode - Selection of B/C provides the arm, automatic capture and tracking of the non-precision approach localizer/MLS back course beam.
- Half Bank Mode - When active, half bank mode limits the maximum commanded roll angle to 15 degrees. The half bank mode is automatically selected when climbing through the half bank transition altitude of 18,000 feet.
- Pitch Mode - Pitch mode is the basic vertical operating mode, and is active when no other vertical mode is active.
- Altitude Select Mode - Altitude select mode, which is armed whenever a flight director is active or the autopilot is engaged, preselects altitudes of 0 feet to 55,000 feet from vertical rates of plus or minus 12,000 feet per minute.
- Overspeed Mode - Overspeed mode is automatically selected when a significant overspeed occurs from all vertical modes except altitude select capture or track, and altitude hold.



525-0433-1-02

MCMASTER

NOTE: DETAILS OF ACTUAL INSTRUMENTS MAY VARY